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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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TUNG & ASSOCIATES
Suite 120
838 W. Long Lake Road
Bloomfield Hills, MI 48302

EXAMINER

DEO, DUY VU NGUYEN

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 05/03/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/072,798

Applicant(s)

TSAI ET AL.

Examiner

DuyVu n Deo

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on amendment filed 3/8/04.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,5,6 and 8-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,5,6,8-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f):
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1, 3-6, 8-14, 21, 22, 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

It is vague about the sequences of the steps “providing a substrate comprising an uppermost patterned hard mask nitride layer free of overlying photoresist” and “isotropically wet etching the hard mask to isotropically reduce the hard mask dimension wherein the wet etching process is selected from the group consisting of spin-spray etching and immersion etching.” The term “the” in the step of “isotropically wet etching the hard mask...” refers to the term that already mentioned but it does not indicates the sequence or order of the steps. The rejection of claims 1, 3-6, 8-14, 21, and 22 are rejected on the notion that there is no particular order between these steps in claim 1.

Claim 24 is vague because it is not clear what etch rate being reduced, the wet etching or the plasma etching. At this time, it seems to refer to the etch rate of the wet etching of the hard mask.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are

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such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1, 5, 6, 8, 9, 14, 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pike et al. (US 6,420,097) and admitted prior art.

Pike describes a hard mask trim process comprising: isotropically etching the metal nitride to reduce the metal nitride's width (claimed isotropically wet etching the metal nitride to reduce a dimension of the hard mask: please also see cited art below for anisotropically and isotropically etching) (col. 4, line 20-29; col. 5, line 3-5); removing the resist layer to form an upper patterned hard mask (this would also provide the uppermost hard mask layer free of overlying photoresist) (fig. 4e; col. 4, line 30-31); anisotropically etching the polysilicon to form a gate structure (claimed anisotropically plasma etching the exposed portion of the polysilicon layer to form a feature) (col. 4, line 34-42).

Unlike claimed invention (also claim 8), Pike is silent about etching metal nitride by processes including immersion or spray etching a solution while simultaneously spinning the wafer. However etching metal nitride by immersion or spray etching while simultaneously spinning the wafer is well known to one skill in the art at the time of the invention as shown in pages, 6, 13-14 of the specification. Also, since Pike is not particular about how to remove the photoresist layer; therefore, at the time of the invention, it would have been obvious for one skill in the art to etch metal nitride to use any method that is available to at the time of the invention such as immersion or spray etching while simultaneously spinning the wafer in order to etch and reduce the metal nitride linewidth and to form a pattern mask for etching the gate with a reasonable expectation of success.

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Referring to claims 5, 6, Pike describes a wafer including at least silicon nitride or titanium nitride overlying a polysilicon layer on a semiconductor substrate (col. 3, line 60-col. 4, line 7);

Referring to claim 9, the spin rate would be obviously determined during the routine experimentation in order to provide the optimum spin rate for the distribution of the solution on the wafer and etching of the wafer with a reasonable expectation of success.

Referring to claim 14, Pike is silent about etching metal nitride by using phosphorous acid at 150-180 degree Celsius. However etching metal nitride using phosphorous acid at 150-180 degree Celsius is well known to one skill in the art at the time of the invention as shown in pages, 6, 13-14 of the specification. Also, since Pike is not particular about how to remove the photoresist layer; therefore, at the time of the invention, it would have been obvious for one skill in the art to etch metal nitride using phosphorous acid at 150-180 degree Celsius as is known to one skill in the art in order to etch and reduce the metal nitride linewidth and to form a pattern mask for etching the gate with a reasonable expectation of success.

Referring to claim 21, Pike describes that the initial linewidth is controllably etched until the desired gate linewidth is achieved. The desired linewidth is less than 0.25 μm (col. 3, line 14-16). It would have been obvious for one skill in the art to determine the desired linewidth through routine experimentation in order to provide optimum linewidth for the gate with a reasonable expectation of success.

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5. Claims 10-13, 15-20, 22, 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pike and admitted prior art as applied to claims 1, 8, above and further in review of Decker et al. (US 4,269,654).

Pike's method described above further includes (claim 15): providing a wafer including multiple layers comprising at least silicon nitride or titanium nitride (claimed metal nitride layer) overlying a polysilicon layer on a semiconductor substrate (col. 3, line 60-col. 4, line 7); patterning a resist layer over the nitride layer in the lithography equipment (claimed photolithographically patterning a photoresist layer over the nitride layer to form a pattern etching surface) (col. 4, line 1-2, line 14-18); anisotropically etching through the metal nitride layer using a pattern photoresist mask to form a hard mask (claimed plasma etching through a thickness of the nitride layer to form a hard mask: please also see cited art below for anisotropically and isotropically etching) (col. 4, line 14-18; col. 15, line 1-3); isotropically etching the metal nitride to reduce the metal nitride's width (claimed isotropically wet etching the metal nitride to reduce a dimension of the hard mask: please also see cited art below for anisotropically and isotropically etching) (col. 4, line 20-29; col. 5, line 3-5); removing the resist layer to form a surface comprising sidewall and upper surface of the hard mask (fig. 4e; col. 4, line 30-31); anisotropically etching the polysilicon to form a gate structure (claimed anisotropically plasma etching the exposed portion of the polysilicon layer to form a feature) (col. 4, line 34-42).

The removing of the photoresist by immersion or spray-etching (claim 17), mentioned above by admitted prior art, would form a wet etching surface comprising sidewall and upper surface of the hard mask

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Referring to claims 10, 11, 13, 15, 16, 18, and 22, Pike is silent about etching the metal nitride using HF, glycol, and water. However, using HF, glycol, and water for etching metal nitride such as silicon nitride is known to one skill in the art as shown here by Decker. The etching T is about 80-120 degree Celsius (claims 1, 3, 5-7). Also, Pike is not particular about what type of solution would be used. Therefore, at the time of the invention, it would have been obvious for one skill in the art to etch metal nitride in light of Decker because Decker shows the solution, which is silent by Pike, for etching the metal nitride and reducing the linewidth of the metal nitride to form a mask for etching the gate with a reasonable expectation of success.

Referring to concentration of the compounds in the etching solution (claim 12, 19), Decker suggests that the etching rate can be varied by varying the concentration of the HF (col. 3, line 40-42). Therefore, at the time of the invention, it would have been obvious for one skill in the art to determine the concentration of HF and other compounds in the solution through test runs in order to provide optimum concentration to etch the metal nitride with a reasonable expectation of success.

Referring to claim 20, Pike describes that the initial linewidth is controllably etched until the desired gate linewidth is achieved. The desired linewidth is less than 0.25 μm (col. 3, line 14-16). It would have been obvious for one skill in the art to determine the desired linewidth through routine experimentation in order to provide optimum linewidth for the gate with a reasonable expectation of success.

Referring to claim 23, the spin rate would be obviously determined during the routine experimentation in order to provide the optimum spin rate for the distribution of the solution on the wafer and etching of the wafer with a reasonable expectation of success.

6. Wolf et al. is cited to show prior art, pages 529, 539.

Response to Arguments

7. Applicant's arguments filed 3/8/04 have been fully considered but they are not persuasive.

Referring to applicant's argument about Pike doesn't disclose the isotropic trimming processes as claimed by the applicant. Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. Please see Pike, col. 4, line 19-29 for the teaching of isotropic etching.

Referring to applicant's argument that Pike doesn't recognize the linewidth is a result-effective variable, Pike describes that the initial linewidth is controllably etched until the desired gate linewidth is achieved. The desired linewidth is less than 0.25 um (col. 3, line 14-16). This would suggest that the desired linewidth must be determined through routine experimentation in order to provide optimum linewidth for the gate with a reasonable expectation of success.

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Referring to applicant's argument that it is improper to refer to applicant's disclosure to find both the elements of applicant claimed invention and motivation to modify Pike, the motivation of reducing the linewidth by using isotropic etching is taught by Pike, please see col. 4, line 19-29). The element of wet etching providing isotropic etching is an element that is well known to any skill in the art at the time of the invention, please see cited Wolf above. Furthermore, a prior art disclosed anywhere, including in the description, is still a prior art. And since Pike is not particular on the type of isotropic etching; therefore, it would be obvious to any one skill in the art to use any method, available at the time of the invention, that provides isotropic etching. Such method is wet etching. This would include the wet etching process.

Argument that applicant does not teach or claim spray etching with phosphorous acid is acknowledged. However, it doesn't teach against using spray etching with phosphorous acid neither as shown by the original claims.

Allowable Subject Matter

8. Claim 24 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Claim 24 is allowable because there is no suggestion by Pike to change the etch rate (if it refers to the isotropic wet etching the hard mask to isotropically reduce the hard mask dimensions) by reducing as a critical dimension is approached.

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Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DuyVu n Dèo whose telephone number is 703-305-0515.

DVD
12/3/03

